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the stone axes as used to fell trees, and some of these were "gros arbres," and the account shows that the cutting must have been done with somewhat of expedition. His party had iron axes as well as stone, but our author does not compare the two, but calls them all "meschantes." In describing the customary method of camping when enemies were supposed to be near, he tells us that as soon as the Indians had chosen the place for a camp, they immediately began to cut down trees to make a barricade, and he says that they know so well how to do this that in less than two hours they have so strong a defence that five hundred of their enemies would not be able to break into it without great difficulty and loss of life. Then in another passage he speaks of the Iroquois cutting down trees for a similar purpose. Nowhere does he speak of fire as an aid in the process. Indeed in the first case where he tells us of so strong a barricade, he says that they make no fire lest the smoke reveal their presence to their enemies.

From these and similar accounts it seems quite probable, to say the least, that stone axes were used as axes for cutting timber, and with not altogether unsatisfactory results.

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GROSSE'S CLASSIFICATION AND STRUCTURE OF THE BIRD-LICE OR MALLOPHAGA.[1]

ABSTRACT BY PROFESSOR G. MACLOSKIE.

THE Mallophaga, or bird-lice, are wingless insects with incomplete metamorphosis, mandibulate mouth-parts, two or three-segmented thorax, eight to ten abdominal somites. They live on mammals and birds, feeding on their scales, hairs and feathers. The genera which are found on mammals never occur on birds, and *vice versa*. Redi first observed (1688) that there are some lice with haustellate and others with mandibulate mouth-parts. Nitsch (1842) carefully examined them, and Von Giebel (1874) improved on his work.

Nitsch divides them into two chief groups, Philopteridæ and Liotheidæ; the Philopteridæ have filamentous antennæ and no palps; the Liotheidæ have clavate four-jointed antennæ and palps. The Philopteridæ comprise two families: (1) Trichodectes, the only genus, characterized by three-jointed antennæ and one-clawed feet; (2) Philopteridæ, *strictè*, with five-jointed antennæ and two-clawed feet.

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[1] Beiträge zur Kenntniss der Mallophaga, von Dr. Franz Grosse in Strassburg. Zeitschrift für wissenschaftliche Zoologie, Bd. XLII, pp. 530–558, mit Taf. XVIII (1885).

The Liotheidæ have likewise two families: (1) Gyropus, the only genus, having one-clawed feet; and (2) Liotheidæ, *strictè*, with two-clawed feet.

Trichodectes and Gyropus occur only on mammals, the other genera only on birds, and are classified according to the presence or absence of appendages on the head (trabeculæ) and their motility, to the sexual differentiation of antennæ, their attitude, the form of the head, the consistency of the thoracal somites and the form of the last abdominal somites.

PHILOPTERIDÆ, *strictè*.

1. Trabeculæ motile, antennæ nearly alike in both sexes . . . . *Docophorus.*
2. Trabeculæ not motile.
    - *a.* Antennæ filiform, no sexual differentiation.
        - (*a*) Hind-head rounded off, terminal somite of male rounded off. . *Nirmus.*
        - (*b*) Hind-head abruptly angled, abdominal somites fused in the middle *Goniocotes.*
    - *b.* Antennæ of male forcipate by a process from the third segment.
        - (*a*) Hind-head angled, terminal somite of female tubercle-like, of male rounded off. . . . . *Goniodes.*
        - (*b*) Hind-head rounded off, terminal somite of male notched . . . *Lipeurus.*

LIOTHEIDÆ, *strictè*.

1. Mesothorax wanting, antennæ generally concealed.
    - *a.* Head very broad, no orbital sinus . . . . *Eureum.*
    - *b.* Head elongated, with lateral angles directed backwards.
        - (*a*) With sharply marked-off clypeus and shallow orbital sinus *Læmobothrium.*
        - (*b*) With only wavy head-margins, and long lateral lobes on the labrum *Physostomum.*
2. Mesothorax present.
    - *a.* Mesothorax large, sharply marked-off, head three-sided, antennæ concealed *Trinotum.*
    - *b.* Mesothorax small, only indicated.
        - (*a*) Orbital bay deep, antennæ mostly elongated and visible. *Colpocephalum.*
        - (*b*) Orbital bay very shallow or obsolete, antennæ concealed. . . . *Menopon.*

Grosse's researches have been largely on a Liotheid found on a pelican from Chili, closely related to Menopon and forming the type of a new genus and species, *Tetrophthalmus chilensis.* The male is 4–4½$^{\mathrm{mm}}$ long, the female slightly less. He also contributes important emendations of our knowledge of the other species.

Head.—In Tetrophthalmus the head is somewhat constricted, is broader than long, slightly convex above, concave below, and somewhat uniform, the occipital angles being rounded off. The hinder limit of the clypeus shows on each side a notch, about a third from the front of the head; two dark spots are seen on each side of the head, the larger one near the notch, the other behind it and outwards. The antennæ lie concealed in a lateral cavity of the under side of the head (as in Læmobothrium, Fig. 1 *at*). Two eyes, whose pigment is seen from above, lie on each side below and behind the antennal cavity. Hairs are distributed over the head, along the borders and on its ventral and dorsal surfaces. On the under side of the head is the funnel-shaped mouth-opening, surrounded by the mandibulate mouth-parts. Grosse describes the mouth-parts of Mallophaga in detail, as previous writers err greatly regarding them.

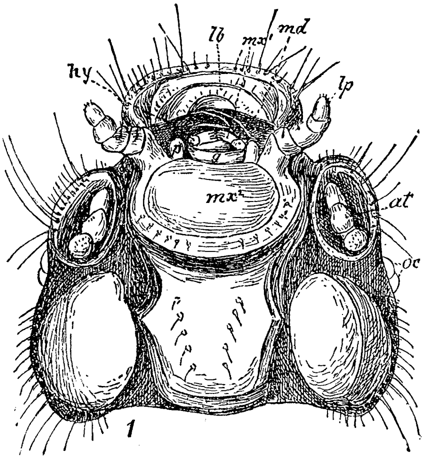

FIG. 1.[1]—Ventral view of head of Læmobothrium from *Gypogeranus serpentarius.* × 30.

Labrum (oberlippe).—This is not, as in other insects, inserted on the anterior border of the head, but in all Mallophaga it is

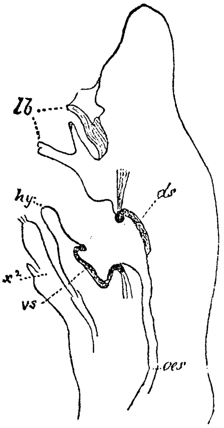

Fig. 2.

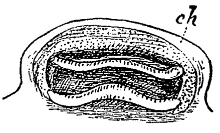

Fig. 3.

FIG. 2.—Median section through head of *Goniodes dissimilis.* × 60. FIG. 3.—Labrum of *Goniodes dissimilis.* × 60.

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[1] *Explanation of reference letters in the figures.—at,* antennæ; *ch,* chitinous bar; *ds, vs,* dorsal and ventral parts of œsophageal sclerites; *g,* glossa (ligula); *gs,* glassy body; *h,* hypodermis; *hy,* hypopharynx; *is, os,* inner and outer side of maxilla; *l,* lens-shaped chitinous thickening; *lb,* labrum (upper lip); *l.md, r.md,* left and right mandible; *lp,* labial palp; *m,* muscle; *md,* mandible; *mt,* mentum; *mx*¹, 1st maxilla; *mx*², 2d maxilla (labium or under lip); *oc,* eyes; *oes,* œsophagus; *on,* optic nerve; *p,* paraglossa; *r,* retinal cells.

on the under side of the head. In all Liotheidæ it is similarly formed (Fig. 1 *lb*), being a thin transverse arched swelling, with chitinous margins bearing small bristles. The labrum of the Philopteridæ has a broad disk-like basis fixed on the under side of the head, and is divided by some transverse furrows (Figs. 2, 3, 5 *lb*). There is a broad furrow, separated from the mouth by a plate of chitin, and farther forward a deep narrow furrow, next the anterior boundary of the labrum. In the living animal the labrum is constantly moving; and in Philopteridæ it can adhere to glass like a suctorial disk. The labrum can thus hold on to hairs or feathers.

Mandibles.—As a type we take the mandibles of Tetrophthalmus (Fig. 4). They have each two strong, long teeth, somewhat different in their structure.

The under tooth of the left mandible has a protuberance with curved point and an arched surface; its upper tooth has two points. The right mandible has two stout teeth which fit the left mandible on closing. This serves for cutting particles held between the labrum and the first maxillæ. The large pointed teeth serve for removing dermal scales. The mandibles of the Philopteridæ are long, triangular and two-toothed, the teeth short and thick (especially in genus Docophorus).

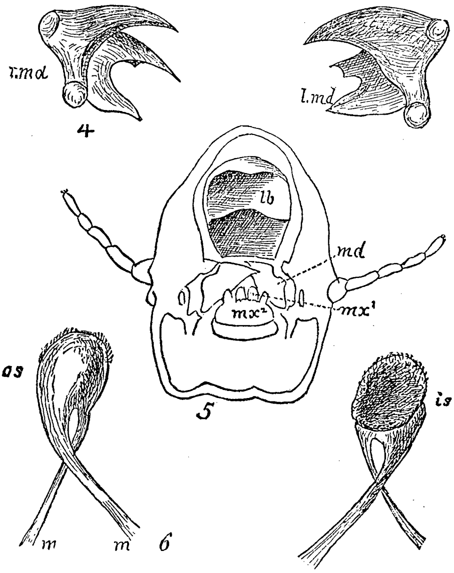

FIG. 4.—Right and left mandibles of Tetrophthalmus. × 60. FIG. 5.—Head of *Lipeurus heterographus*, seen from below. × 60. FIG. 6.—First maxillæ of Tetrophthalmus. × 75.

First maxillæ.—These are conical, and have a basal and a terminal segment or blade, distinguishable in young specimens. The inner side of the blade has hooklets (not in Docophorus) (Figs. 5, 6). The maxillæ seem to take no part in comminuting the food beyond aiding in its prehension. With all care

Grosse has never been able to find the palps of the first maxillæ which Nitsch ascribes to Liotheidæ. Nitsch figures them in *Trinotum conspurcatum*, but this can scarcely be correct, for he places the four-jointed papillæ on the blade near its anterior border. In Tetrophthalmus the palps belong not to the first but to the second maxillæ. The same is true of *Menopon pallidum*, *Colpocephalum zebra*, a Læmobothrium from *Gypogeranus serpentarius*, and a Trinotum from the swift, and probably is the case with all the genera and species.

Second maxillæ (unterlippe).—These are flat, fused, bounding the mouth posteriorly. They consist, in Liotheidæ, of two parts which are united by a transverse fold (Fig. 8). The basal part (mentum, *mt*) represents the coalescing stipites and squamæ of normal first maxillæ, and bears the four-jointed labial palps. The upper part is the ligula or glossa (*g*) corresponding to the inner blade [lacinia]. Laterally on the ligula are the paraglossæ (*p*), corresponding to the outer blade [galea]. A chitinous band limits the glossa where it bears the paraglossa, as if the parts of both had coalesced.

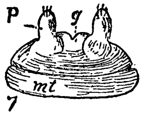

FIG. 7.—Second maxillæ of Nirmus. × 60.

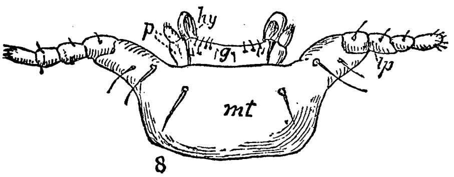

FIG. 8.—Second maxillæ of *Tetrophthalmus chilensis*. × 60.

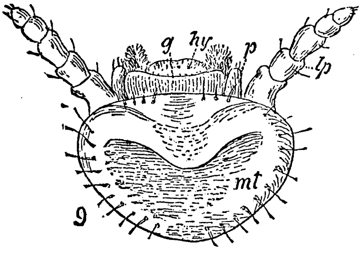

FIG. 9.—Second maxillæ of Læmobothrium. × 60.

Rudow seems to have mistaken the antennæ for the labial palps. Melnikow overlooked the labium, and erroneously compared the products of the œsophageal intima with the proboscis of Pediculina, in consequence of this false comparison referring the Mallophaga to Rhynchota.

The labium of the Philopteridæ has no palps (Fig. 7). It is usually triangular, with rounded angles, and is sometimes very small, as in the genus Lipeurus, the mentum being smaller than the ligule. The ligule is emarginated in Docophorus and Lipeurus. The paraglossæ of Philopteridæ, as in the Liotheidæ, are like tactile-organs, remarkably long in species of Goniodes.

In all Liotheidæ the intima of the ventral end of the oral cavity forms a fold-like duplicature as in Philopteridæ (hypopharynx, Fig. 2 *hy*). In Læmobothrium and Tetrophthalmus this extends forward over the labium, and its lateral borders are strongly bent upwards (Figs. 1, 8. *hy*).

For the study of the head Grosse made transverse and sagittal sections of specimens fresh from molting and hardened in chromic or picric acid. From absolute alcohol they were placed in chloroform and after two hours embedded in paraffine, being kept for a time in melted paraffine under the air-pump. The sections were attached to the slide by means of albumen or oil of cloves, stained by alcoholic carmine-solution, treated with acidulated alcohol so as to show the nuclei, and then enclosed in Canada balsam.

Thorax.—In the genera Trinotum, Colpocephalum and Tetrophthalmus the three thoracic somites are present, especially manifest in the young. The prothorax of Tetrophthalmus has above a rounded swelling, and ends forwards in a bristly point on each side. Within the prothorax, but visible through the transparent dorsum, is a cross-band of chitin, as in Menopon, for the attachment of muscles. The mesothorax is much narrower than the other thoracic somites. The metathorax is of trapezoidal form, and much broader and shorter than the prothorax. The borders of these somites are strongly chitinized. There are no wings or rudiments of wings. The foremost of the three pairs of limbs are the shortest, and they act as foot-jaws, drawing fragments of food to the mouth. In the male Tetrophthalmus they are large and also serve for holding the female. The tibia of all the limbs of the male have their inferior end extending into a knob with sharp processes like a "morning star." There are only two tarsal joints, the distal one being the longer and bearing two incurved claws, inclosing between them a soft lobe [pulvillus]. The bristles on the tibia and the "morning-star" processes of the male serve for holding the female, which indeed often clambers among the feathers of the host.

Abdomen.—The female of Tetrophthalmus has ten abdominal somites, the terminal one soft and rounded. The male has nine, as the last is invaginated so as to serve as a sheath for the penis; the hind end of the male is pointed and more chitinized, and more darkly colored than in the female.

Digestive track.—Two types of crop are found in the Mallophaga. In Philopterida the crop is a lateral diverticulum of the œsophagus; in Liotheidæ it is a club-shaped symmetrical enlargement of the œsophagus. Kramer divides the intestine of Lipeurus into an oral-cavity, an œsophagus, crop, chylus-stomach and hind-intestine. The œsophagus reaches back to the abdomen, and has a homogeneous chitinous intima. The intima of the crop has spines, and its cells appear to secrete a fluid. The chylus-stomach extends to the entrance of the malpighian tubules. Grosse finds in the œsophagus of Tetrophthalmus, behind the hypopharynx, a chitin-bar produced by thickening of the intima, consisting of a groove-like mid-piece, and running forward and backward into two diverging branches. The hind branches have muscles from the occipital border of the cranium. These chitinous bars are not haustellate, but support the oral intima, and in their groove are sent along comminuted fragments of feathers, retained by the retrorse spines and denticulations of the dorsal part of the intima.

Goniodes has two squamous œsophageal pieces, a dorsal and a ventral (Fig. 2, *ds*, *vs*). The ventral piece has posterior processes joined by muscles with the occipital border. The dorsal piece sends forward a muscular bundle, which bifurcates and its divisions are inserted on the anterior cranial border. Two ducts (probably salivary) run forwards through these scale-like pieces, uniting into one. The chylus-stomach is cordate at its beginning, and has no chitinous intima. The hind-intestine has six longitudinal grooves, and rectal glands with richly branching tracheæ and a chitinous intima.

The mode of nutrition of Mallophaga is not fully ascertained. Nitsch stated that they eat the epidermal products of birds and mammals, and sometimes blood. Grosse finds that blood is rarely taken, and only in cases where the bearers (birds) are so injured or diseased as to have blood among their plumage; and Leuckart gives the same result as to *Trichodectes canis* of the dog. In Læmobothrium, Grosse found the intestine filled with the limbs of its own kind, as if it ate the product of its own molting.

Malpighian vessels.—These are four, not branched; have a lumen and ganglion-cells (not separated from the lumen by any membrane).

Salivary glands.—There are two pairs; and exceptionally the Philopteridæ have one-celled glands as on the crop. Grosse found one of these cells undergoing division. The salivary organs include salivary glands and salivary reservoirs. The glands usually adjoin the crop or stomach, and have a cell-layer with nuclei, covered externally and internally by a fine homogeneous epithelium. Before the entrance of thin ducts into the œsophagus, a gland and a salivary vessel unite into a common duct.

Sexual organs.—The male sexual organs are of the usual type of insects, paired testes, spermatic ducts, a seminal vesicle, ejaculatory duct and penis. Nerves supply the seminal vesicle and ejaculatory duct; and in Tetrophthalmus the terminal somite of the abdomen is withdrawn so as to be concealed, serving as a sheath for the penis. The female organs consist of paired ovaries (three pairs of ovarian tubes in Liotheidæ, five pairs in Philopteridæ), two oviducts uniting into one and a seminal receptacle. The egg-case has a lid which springs open at the exit of the young insect.

Respiratory apparatus.—There are seven pairs of stigmas, one in the prothorax and six abdominal. Each stigma has internally a crown of fine hairs to protect from impurities. A pair of strong longitudinal tracheæ send branches to the stigmata and are united to each other by a strong cross branch in the abdomen, and smaller ones in the head and thorax.

Dorsal vessel.—Grosse could not succeed in making a preparation of this, but in the recently molted living animal it can be seen pulsating through the back.

Nervous system.—This consists (in Philopteridæ) of two cephalic ganglia and three thoracic ganglia. The preœsophageal ganglion is much larger than the subœsophageal, and they are united by strong commisures. The last thoracal ganglion is large, and sends back nerves to supply the abdomen.

Antennæ.—In Liotheidæ these are four-segmented, club-shaped or knobbed, the terminal segment spherical, lying in a hollow of the sub-terminal one (Fig. 1 *at*). In a cross-section of the terminal segment of Læmobothrium are seen round nucleated cells, apparently ganglionic enlargement of nerves. The Liotheidæ have the antennæ alike in both sexes, but in Philopteridæ the third segment of the antennæ of the male has a lateral process, sometimes so large as to make the antenna resemble a lobster's claw. Nitsch states that it is for holding the female.

Eyes.—These lie on the margin of the under surface of the head behind the antennæ. Authors have hitherto ascribed a single pair of eyes to all Mallophaga. But in all Philopterid genera examined (Goniodes, Docophorus, Lipeurus, Nirmus) the author found a single pair, and in all Liotheid genera (Tetrophthalmus, Læmobothrium, Menopon, Trinotum and Colpocephalum) he found two pairs of stemmata. If this character holds good for the remaining genera it will still further separate the two chief divisions of the Mallophaga.

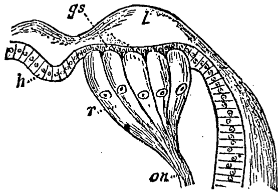

FIG. 10.—Eye of Læmobothrium seen on cross-section of head. × 190.

The eyes of Mallophaga are simple, provided with a lens-shaped thickening of the cuticle. In young specimens the eye has no pigment, but in older specimens it has pigmented retinal cells. The eye of Læmobothrium, examined by means of sections, has, under the chitin-thickening (Fig. 10 *l*), twenty-four pigmented retinal-cells (*r*), clavate and nucleated with nucleoli, merging gradually into the pigmented optic nerve (*on*). Each eye is directly innervated from the preœsophageal ganglion. The hypodermal cells are interposed between the lens and the retinal-cells, as cubic cells in old specimens, but as a hyaline body consisting of cylindrical cells in young or recently molted specimens. There are no rhabdites in the eyes. The eyes of Mallophaga resembles those of *Phryganea grandis*, as described by Grenacher.

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TRACK OF A CYCLONE WHICH PASSED OVER WESTERN INDIANA MORE THAN THREE HUNDRED YEARS AGO.

BY JNO. T. CAMPBELL.

LAST April (1885) I was surveying in the west-central part of Parke county, Indiana. On the south side of Section 16, Township 15 north, of Range 8 west, I noticed that the tree graves were very numerous, there being one to every square rod